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Yeung et al.

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[45] Date of Patent: Jul. 1, 1997

[54] **TOASTER WITH COVER FOR REDUCED ENERGY CONSUMPTION**

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[51] **Int. Cl.**[6] **A47J 37/08**

[52] **U.S. Cl.** **99/334**; 99/385; 99/391; 99/393

[58] **Field of Search** ..... 99/329 R, 331, 99/332, 395, 326–328, 329 P, 329 RT, 334, 335, 339, 337, 340, 385, 389–393, 399, 401, 402; 219/521, 537, 386, 413

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Primary Examiner—Timothy F. Simone
Attorney, Agent, or Firm—Limbach & Limbach L.L.P.

[57] **ABSTRACT**

A toaster having a mechanically actuated cover for each of one or more toasting volumes. Each cover at least partially covers a toasting volume within the toaster during toasting, thereby reducing heat transfer (primarily due to convection) away from the toaster and the object being toasted. In preferred embodiments, each cover is a pair of slidably mounted plates. When a carriage (supporting an object to be toasted) is manually lowered by a user, a mechanical linkage attached to the carriage cause the plates to slide together to cover (substantially or totally) a toasting volume. When the carriage springs up (at the end of the toasting operation), the mechanical linkage slides the plates away from each other to allow removal of the toasted object from the toaster. In other preferred embodiments, each cover is a pair of rotatably mounted plates. When a carriage supporting an object is manually lowered by the user, a mechanical linkage attached to the carriage rotates (and optionally also translates) the plates so that they cover a toasting volume. Then, when the carriage springs up (at the end of the toasting operation), the mechanical linkage rotates (or rotates and translates) the plates in the opposite direction to uncover the toasting volume and allow removal of the toasted object.

14 Claims, 7 Drawing Sheets

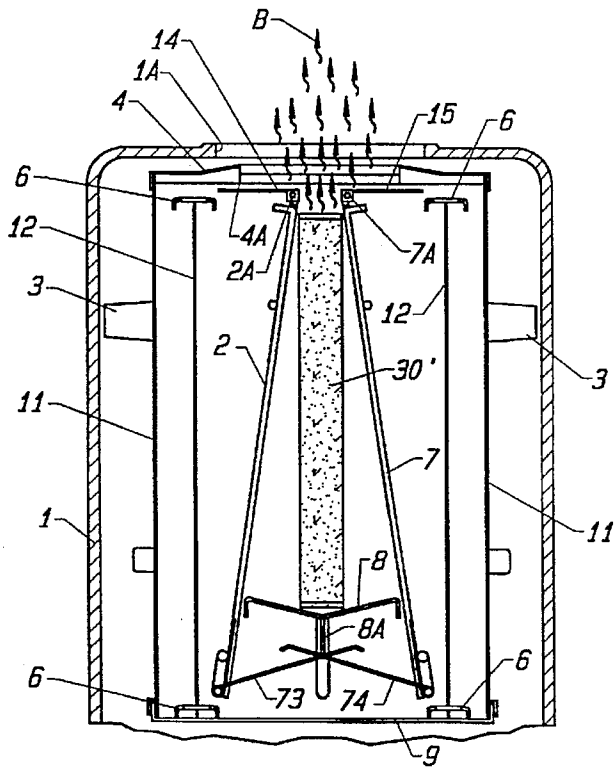
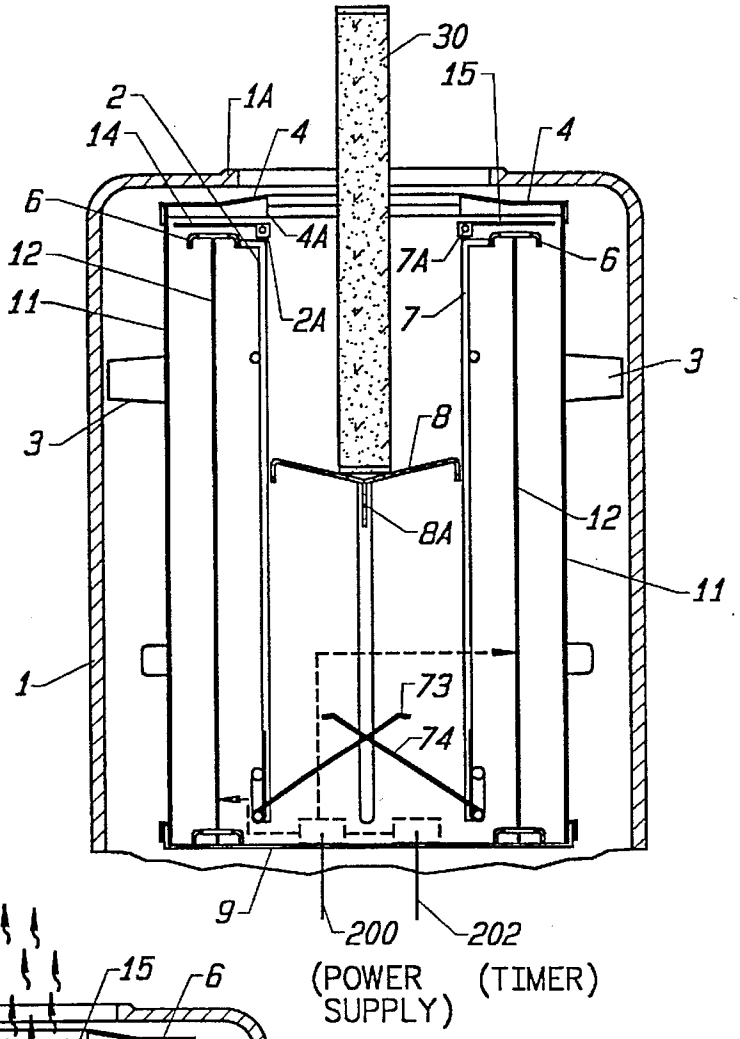


FIG. 1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15
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14
4
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4A
12
7A
6
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2A
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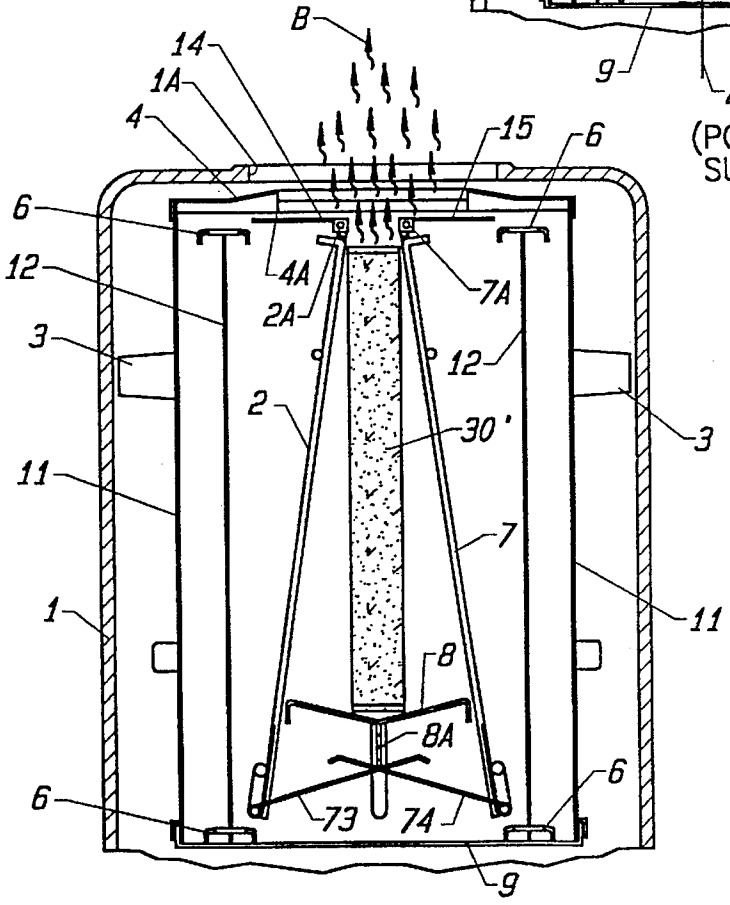
8
8A
12
11
1
73
74
9
200
202
(POWER SUPPLY)
(TIMER)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14
1A
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15
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4A
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3
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7
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74
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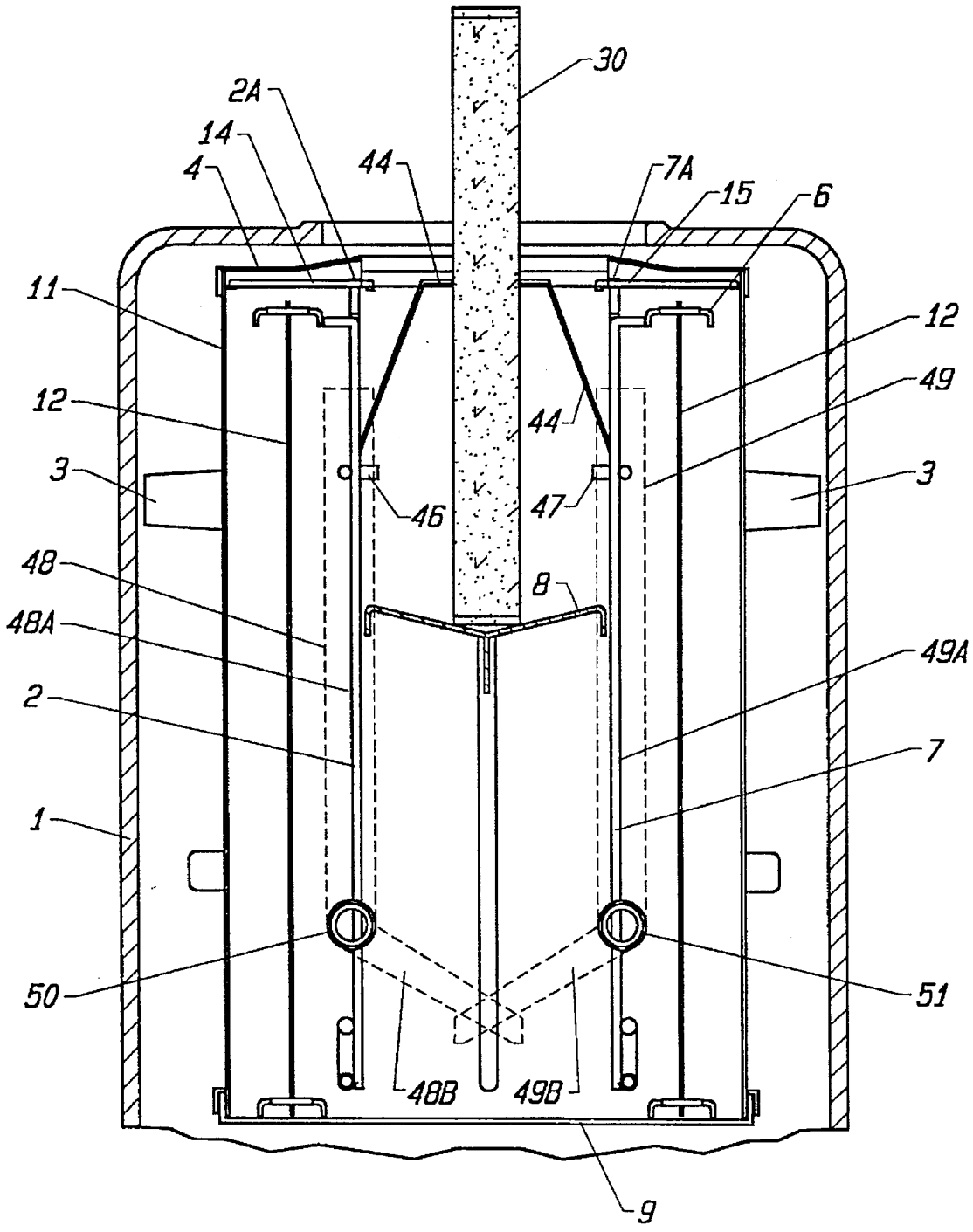
FIG. 2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48A
49A
2
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50
51
48B
49B
9

FIG. 3

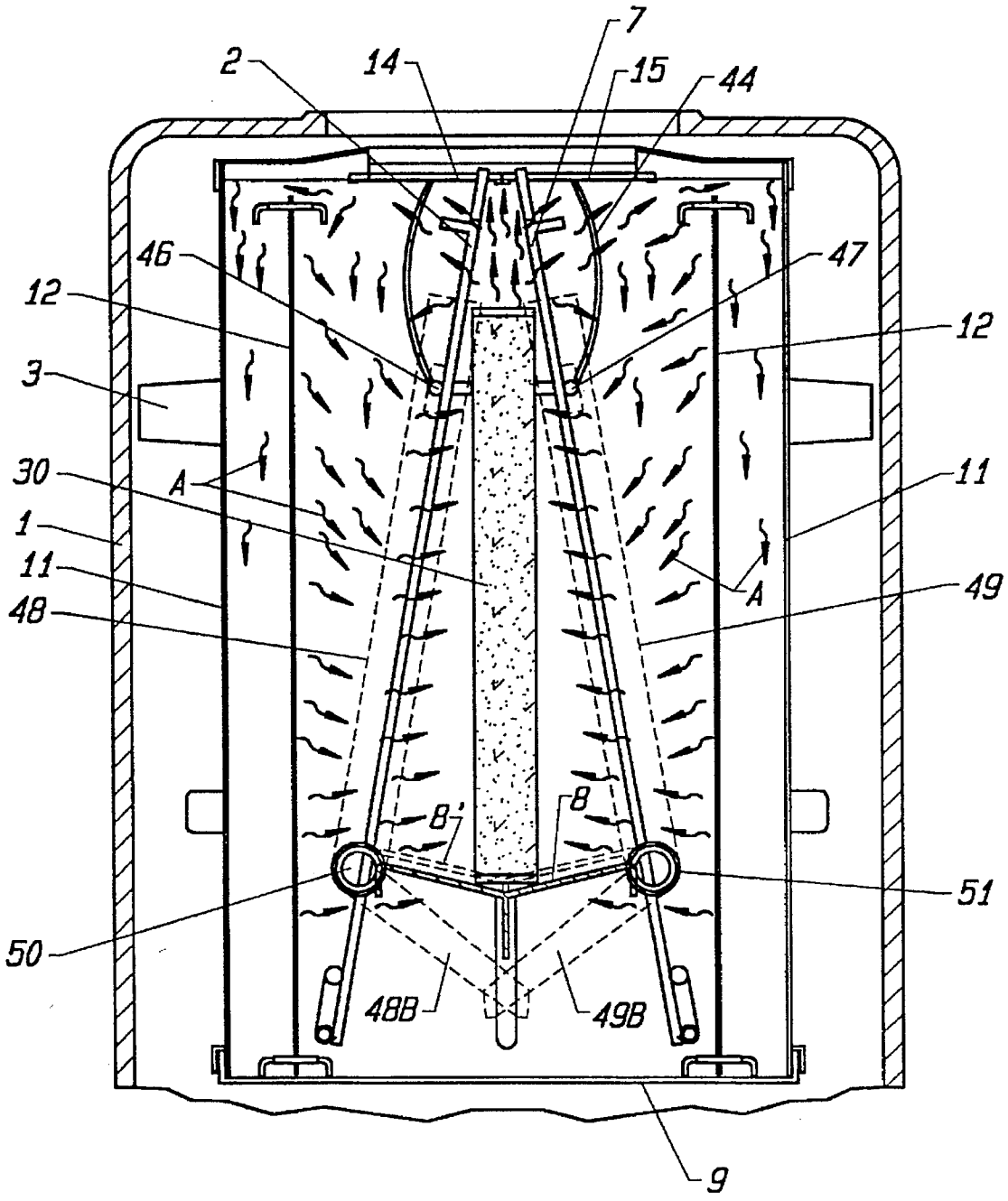


FIG. 4

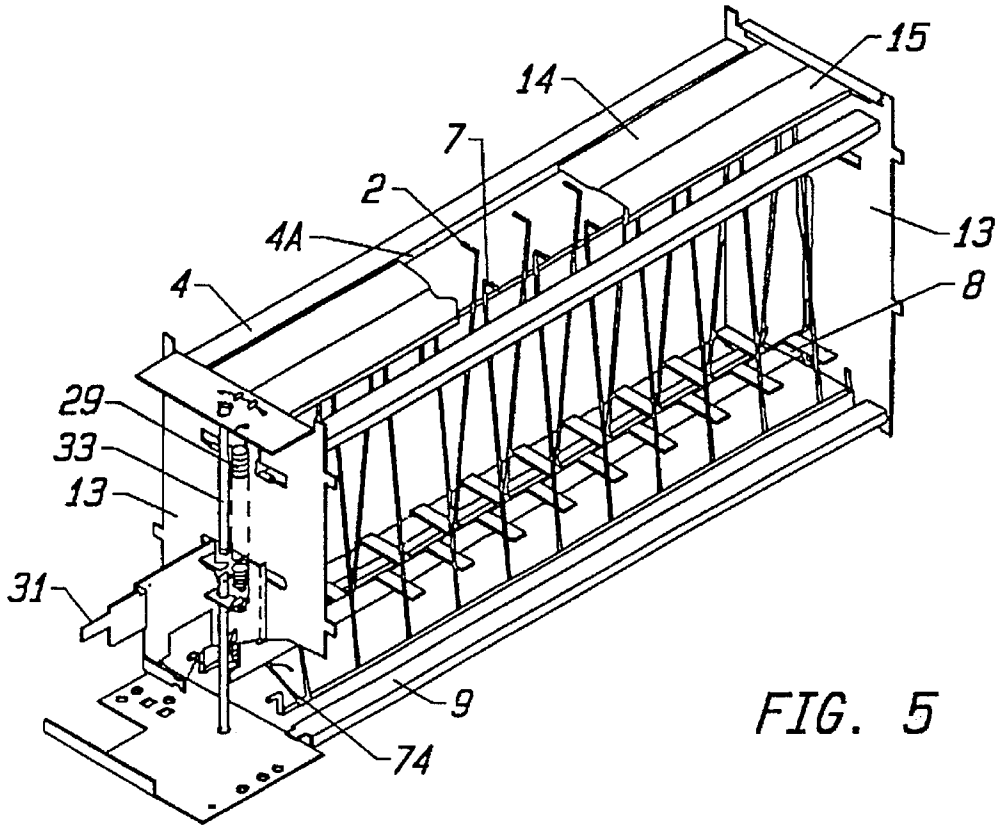


FIG. 5

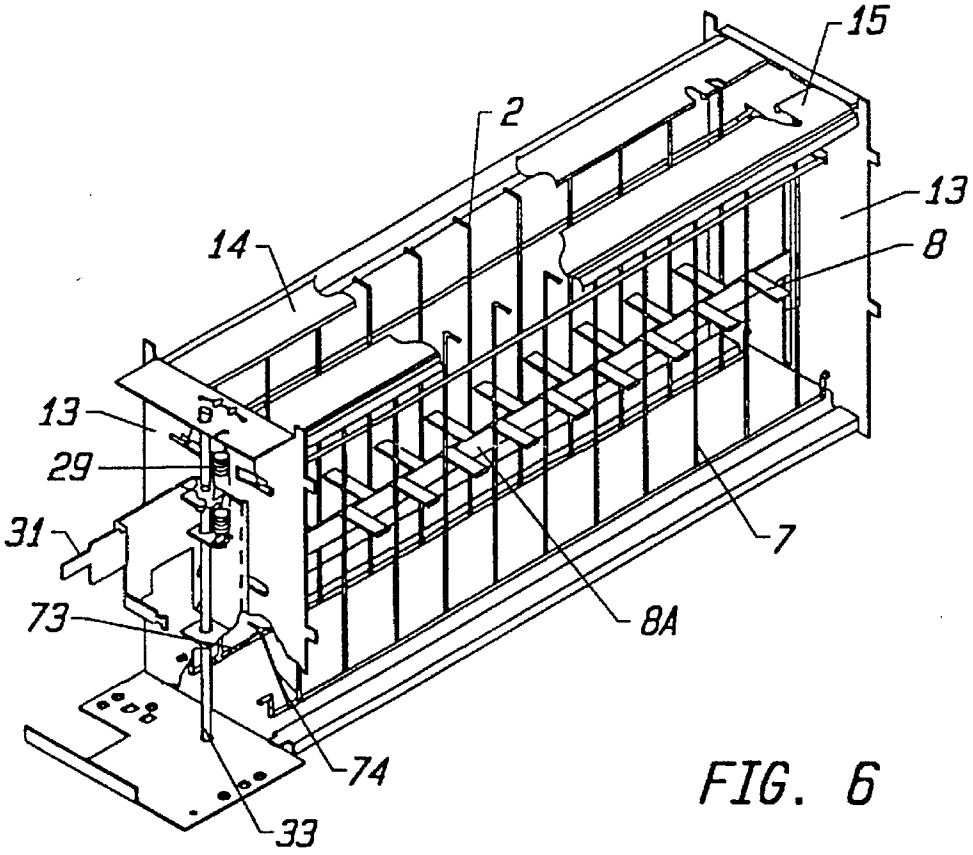


FIG. 6

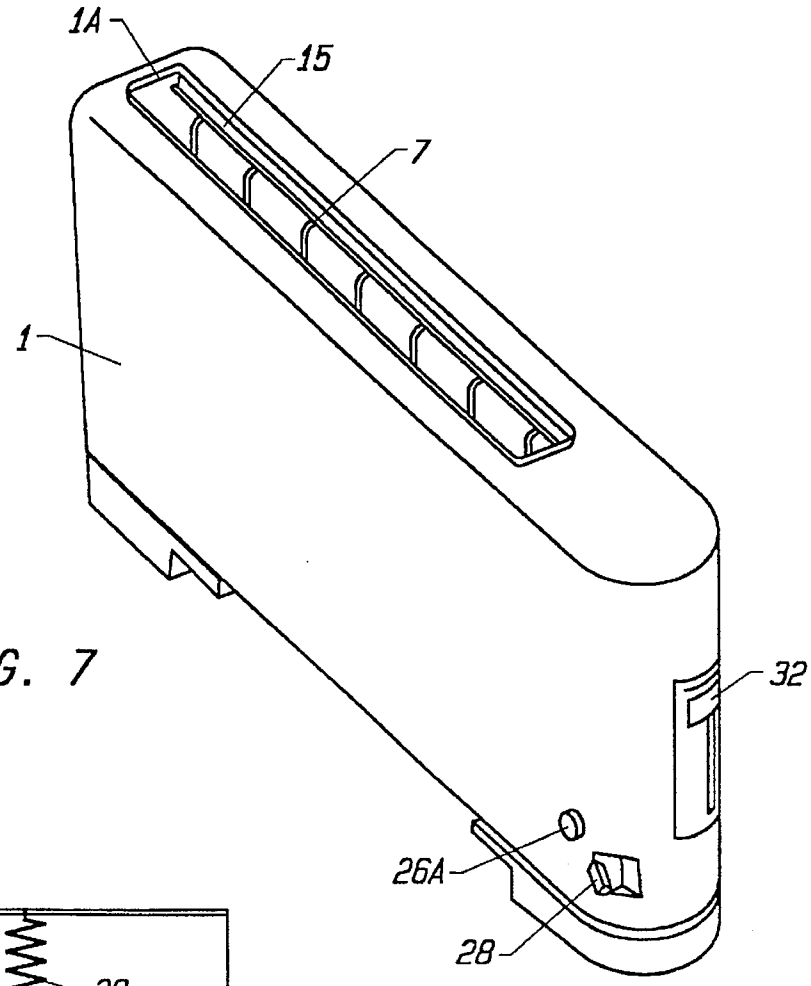


FIG. 7

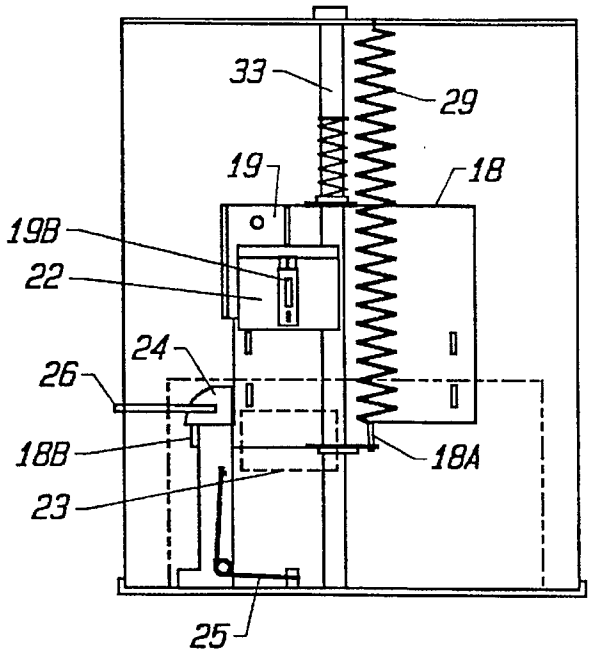
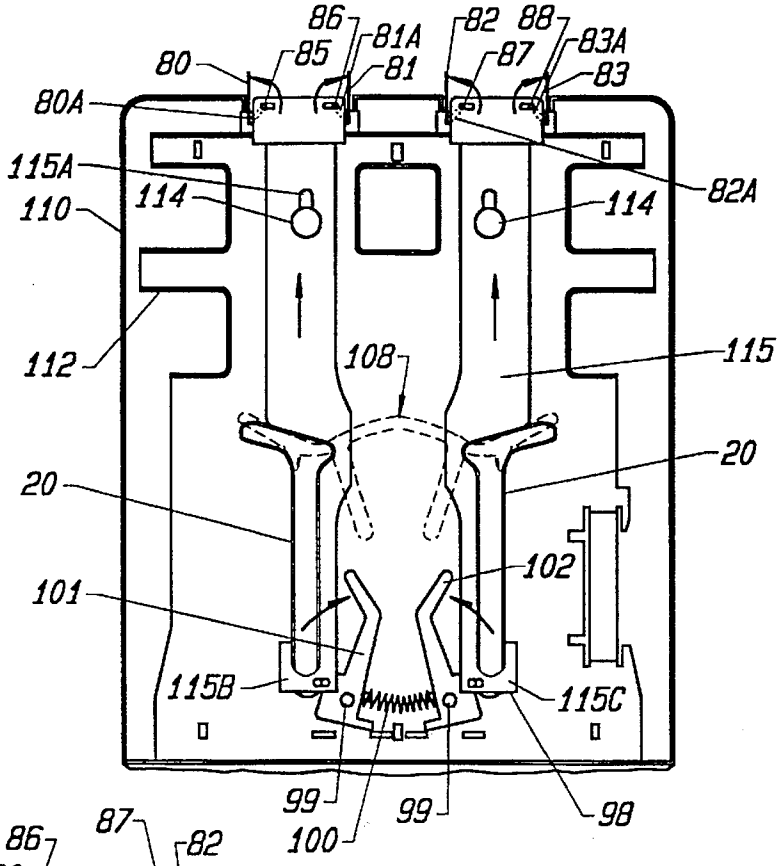


FIG. 8

FIG. 9



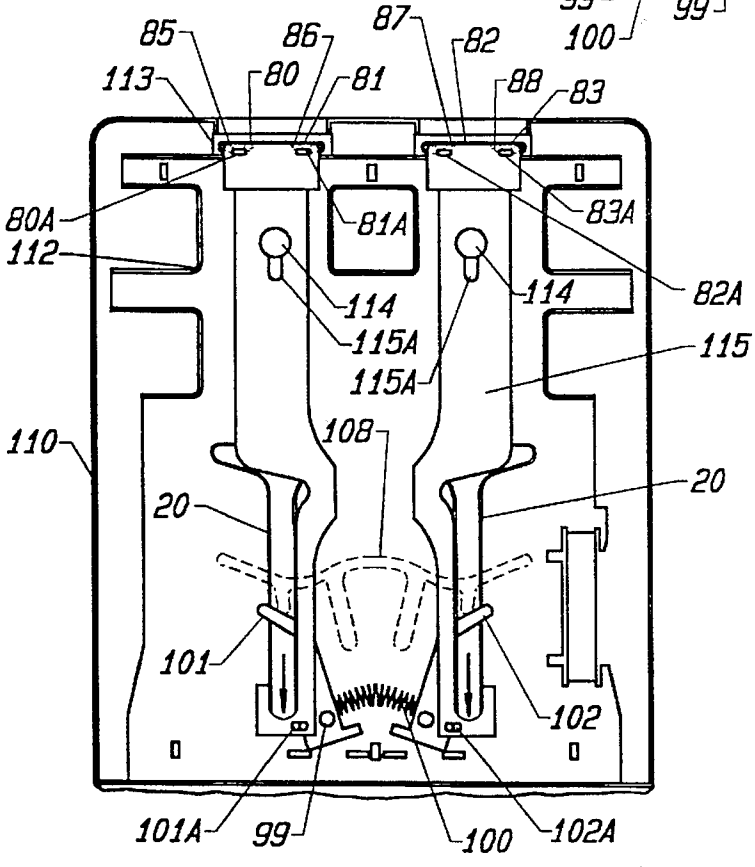


FIG. 10

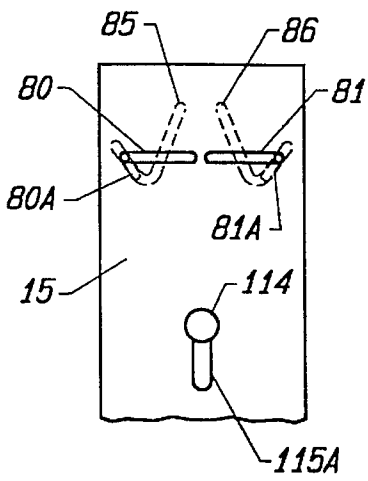


FIG. 10A

FIG. 11

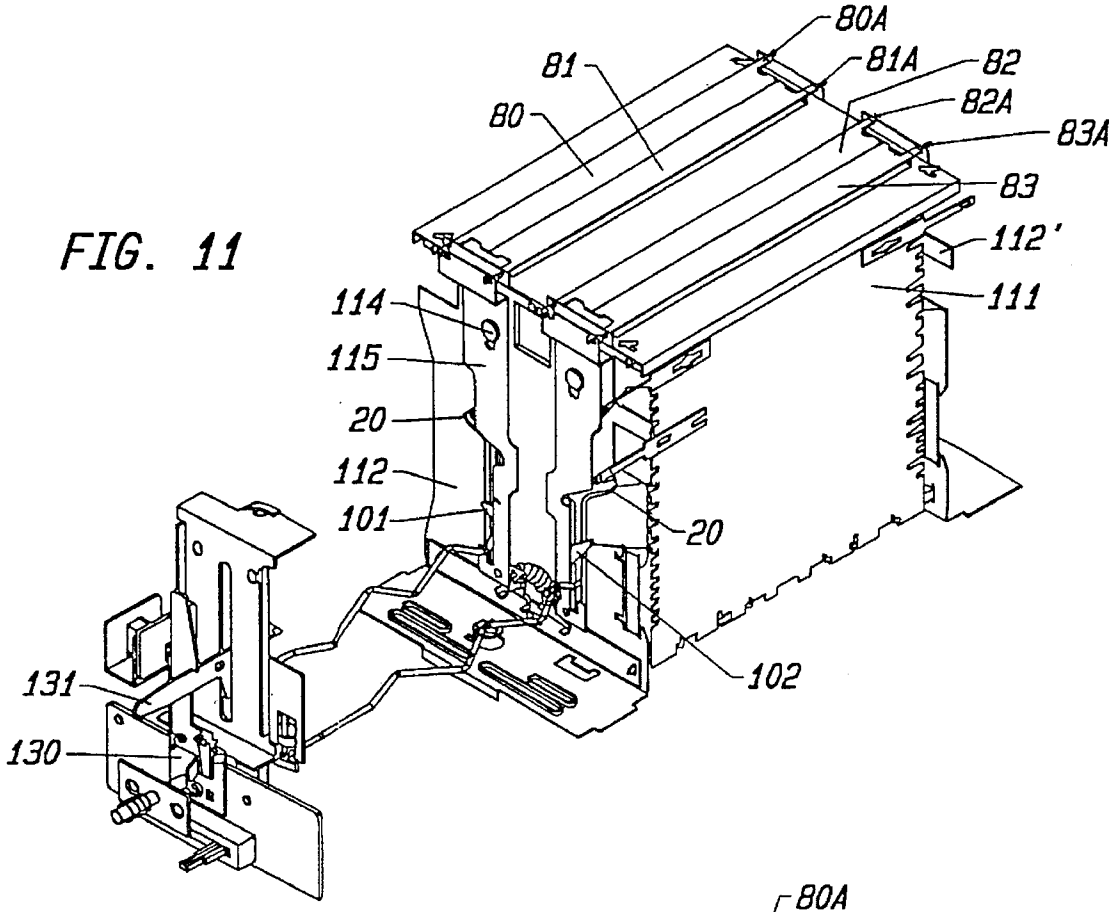

80A
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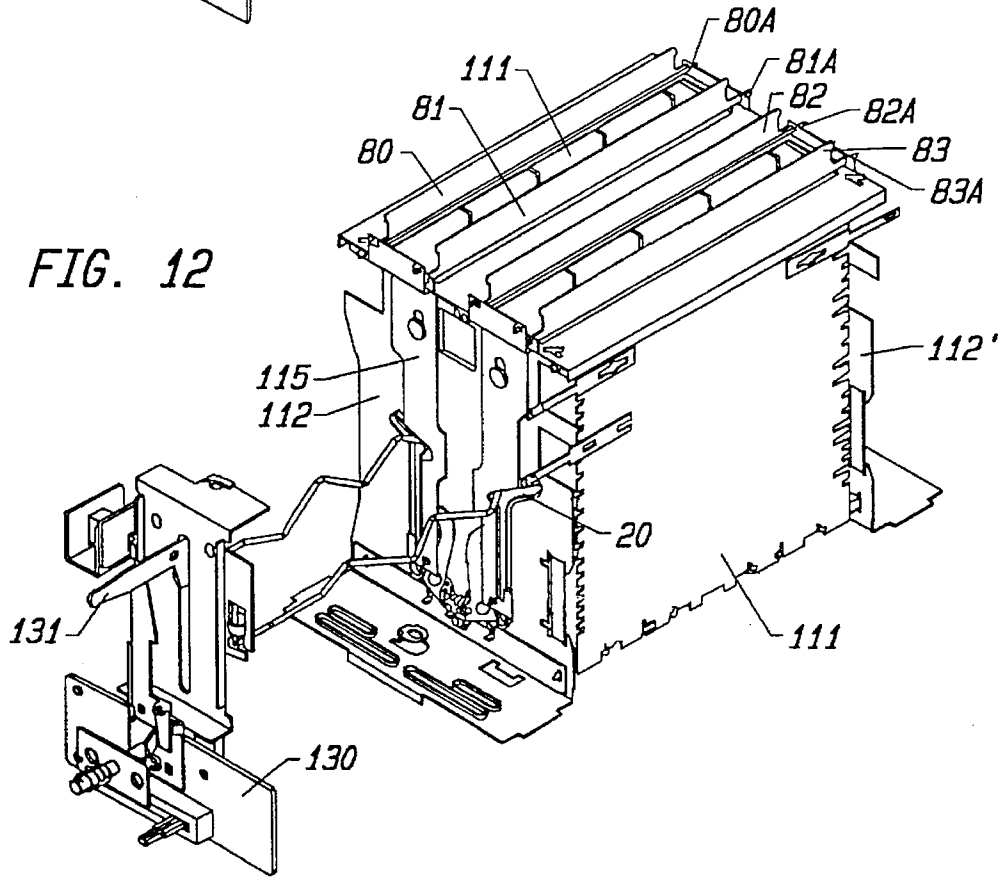
FIG. 12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TOASTER WITH COVER FOR REDUCED ENERGY CONSUMPTION

FIELD OF THE INVENTION

The invention relates to improved energy-saving design for a toaster. The toaster of the invention has a mechanically actuated cover which is closed during toasting to reduce heat loss (primarily heat loss due to convection) away from the object being toasted, and which is opened automatically after each toasting operation, and/or kept closed until opened in response to manual actuation of a control (e.g., a cancellation button) to continuously recycle residual heat energy within the heating compartment of the toaster after each toasting operation.

BACKGROUND OF THE INVENTION

An example of a known toaster is the toaster described in British Patent Application Publication No. 2,285,389A, published on Jul. 12, 1995, assigned to the assignee of the present invention. The disclosure of British Patent Application Publication No. 2,285,389A is incorporated herein by reference.

The toaster of British Application Publication No. 2,285,389A has a bread carriage (**15**) which is biased by a spring (**29**) to be in a raised position, but which can be manually lowered into a lowered position (in response to manual force applied by a user). The action of manually lowering the bread carriage closes an electrical switch thereby connecting a power supply to heating elements within the toaster, and it also activates a solenoid (**23**) and a timer. When activated, the solenoid exerts a magnetic force on elements attached to bread carriage **15** which overcomes the biasing force of spring **29** and holds bread carriage in the lowered position (while the bread is toasted by the power-consuming heating elements).

After being activated at the start of a toasting operation, the timer generates a signal for deactivating the solenoid, at the end of a selected period of time (the duration of this time is determined by manual actuation of a control by a user). When the solenoid is deactivated by the signal from the timer, the carriage rises (in response to the biasing force exerted by spring **29**) until an arm (**18B**) attached to the carriage is caught by a latch (**24**). In response to this limited movement of the carriage to an intermediate position (between the lowered and raised positions), the electrical switch opens (thereby disconnecting the power supply from the heating elements). While the carriage remains in the intermediate position (i.e., while arm **18B** is latched by latch **24**), the cooling of any toasted food resting on the carriage is slowed, since the food remains near the heating elements which themselves cool slowly after being disconnected from the power supply.

When a user wishes to remove the toasted food from the toaster, the user manually actuates another control to release latch **24**, thereby releasing arm **18B** and allowing the carriage to rise (in response to biasing force exerted by spring **29**) from the intermediate position to the fully raised position.

During the toasting period (when power is supplied to the heating elements), the heating elements become hot and transfer heat to the air surrounding them. The heated air flows past the carriage and the food on the carriage, thus toasting the food. In a conventional toaster (which has an open slot above the food being toasted), a continuous stream of air flows through the toaster (from bottom to top) during toasting: cool air flows in through the bottom (and optionally also holes in the sides) of the toaster, the cool air is heated by the heating element, and the heated air then flows out through the slot above the food. Thus, much heat energy is wasted (by the mechanism of convective heat loss) due to the stream of hot air which escapes from the toasting volume.

The energy consumed by a toaster when toasting food is the product of the average power consumed by the toaster's heating elements and the time of the toasting operation. It would be desirable if the consumed energy could be reduced without decreasing the energy transferred to the food.

The present invention achieves this objective by reducing the energy wasted during a toasting operation by at least partially covering the toasting volume during toasting, thereby reducing the amount of heat transfer (primarily heat transfer due to convection) away from the toasting volume. This allows the inventive toaster to toast food either in less time, or with heating elements operating at a lower temperature (and thus drawing less power), than would be required in a conventional toaster.

SUMMARY OF THE INVENTION

The invention is a toaster having a mechanically actuated cover for each toasting volume within the toaster. Each cover at least partially (and preferably, substantially totally) covers a toasting volume during toasting, thereby reducing heat transfer away from the toaster and the object being toasted. In preferred embodiments, each cover is a pair of slidably mounted plates (which can but need not be made of metal or thermally insulating material). When the food lifting carriage is manually lowered by the user, a mechanical linkage attached to the carriage cause the plates to slide together to at least partially cover a toasting volume. Then, when the carriage springs up (at the end of the toasting operation), the mechanical linkage slides the plates away from each other to allow removal of the toasted object from the toaster. Alternatively, the mechanical linkage slides the plates away from each other in response to a user's manual actuation of a lever after a toasting operation; not automatically in response to the carriage springing up at the end of the operation.

In another class of preferred embodiments, each cover is a pair of rotatably mounted plates (which can but need not be made of metal or thermally insulating material). When the food lifting carriage is manually lowered by the user, a mechanical linkage attached to the carriage rotates (and optionally also translates) the plates so that they cover a toasting volume. Then, when the carriage springs up (at the end of the toasting operation), the mechanical linkage rotates (or rotates and translates) the plates in the opposite direction to uncover the toasting volume and allow removal of the toasted object. Alternatively, the mechanical linkage moves the plates away from each other in response to a user's manual actuation of a lever after a toasting operation; not automatically in response to the carriage springing up at the end of the operation.

The inventive cover can be made of metal or other high temperature resistant material. When closed, the cover acts as a barrier to the rising hot air within the toasting volume, causing the hot air to recirculate back to the heating elements and the food being toasted, and reducing the flow rate of incoming cool air through the bottom of the toaster, and the flow rate of hot air escaping out through the top of the toaster. In a given time, the heating elements can raise the recirculated hot air to a higher temperature than the temperature to which they could raise an equivalent amount of

cool air freshly taken in through the bottom of the toaster. Thus, when used with the inventive closed cover, the heating coils cause the transfer of more heat to the food while drawing the same power as heating coils in a conventional toaster without a cover. Thus, food can be toasted to the same degree in less time, or in the same time but with less average power supplied to the heating elements, than in a conventional toaster. The inventive cover thus increases the energy efficiency of a toaster.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view (in a first plane) of a first preferred embodiment of the inventive toaster with bread carriage **8** in a raised position.

FIG. **2** is a cross-sectional view (in the first plane) of the first preferred embodiment of the inventive toaster, with bread carriage **8** in a lowered position.

FIG. **3** is a cross-sectional view (in a second plane) of the first preferred embodiment of the inventive toaster with bread carriage **8** in the raised position.

FIG. **4** is a cross-sectional view (in the second plane) of the first preferred embodiment of the inventive toaster, with bread carriage **8** in the lowered position.

FIG. **5** is a perspective view of the toaster of FIGS. **1–4** (with enclosure **1**, walls **11**, and handle **32** removed), with carriage **8** in the lowered position.

FIG. **6** is a perspective view of the toaster of FIGS. **1–4** (with enclosure **1**, walls **11**, and handle **32** removed), with carriage **8** in the raised position.

FIG. **7** is a perspective view of a variation on the toaster of FIGS. **1** and **3**, with the bread carriage (within enclosure **1**) and handle **32** (rigidly connected to the bread carriage) in their fully raised position.

FIG. **8** is an end view of the toaster of FIG. **7** (with enclosure **1** and handle **32** removed), with the bread carriage latched (by latch **26**) in its intermediate position.

FIG. **9** is a cross-sectional view (in a first plane) of a second preferred embodiment of the inventive toaster with its bread carriage in a raised position.

FIG. **10** is a cross-sectional view (in the first plane) of the second preferred embodiment of the inventive toaster, with its bread carriage in a lowered position.

FIG. **10A** is an enlarged detail of a portion of the apparatus of FIG. **10**.

FIG. **11** is an exploded perspective view of the toaster of FIGS. **9–10** (with enclosure **110** removed), with the bread carriage in the lowered position.

FIG. **12** is an exploded perspective view of the toaster of FIGS. **9–10** (with enclosure **110** removed), with the bread carriage in the raised position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A toaster designed in accord with a preferred embodiment of the invention will be described with reference to FIGS. **1–6**. This embodiment has a cover consisting of slidably mounted metal plates **14** and **15**. When bread carriage **8** is manually lowered by a user (into the position shown in FIG. **2**), a mechanical linkage attached to carriage **8** causes plates **14** and **15** to slide together to cover (at least partially) a toasting volume within the toaster. To toast an object (e.g., slice of bread **30** of FIGS. **1**, **3**, and **4**, or slightly larger slice of bread **30'** of FIG. **2**) in the toasting volume, the object is placed on carriage **8**, the carriage is lowered into a lowered position in which the object is within the toasting volume (e.g., the position shown in FIG. **2**), and the carriage is releasibly latched into the lowered position.

As shown in FIGS. **1–4**, the toaster has a chassis (or "frame") which includes vertically oriented insulation plates **11**, horizontally oriented bottom plate **9** connected between plates **11**, horizontally oriented top insulation member **4** connected between plates **11**, end plates **13** (shown in FIGS. **5** and **6**) oriented parallel to the plane of FIG. **1**, and vertical rod **33** (shown in FIGS. **5** and **6**) attached to one of end members **13**. The frame is mounted within enclosure (or "housing") **1**, and spacer members **3** are mounted between enclosure **1** and each plate **11** to stabilize the frame with respect to enclosure **1**.

Carriage **8** within the frame is rigidly connected to a handle assembly, and the handle assembly is slidably mounted to rod **33** of the frame. The handle assembly comprises handle member **31** (rigidly connected to carriage **8**) and a handle attached to an end portion of member **31** (a handle such as handle **32** shown in FIG. **7**). In response to force exerted on handle **32** (typically by the hand of a human user), carriage **8** is lowered relative to the frame from the raised position shown in FIG. **1** (and FIG. **3**) to the lowered position shown in FIG. **2** (and FIG. **4**). Carriage **8** is biased by extension spring **29** (shown in FIGS. **5** and **6**) so that it is normally in the raised position. The action of manually lowering carriage **8** to the lowered position thus overcomes the biasing force exerted by spring **29**. The mechanism for releasibly locking carriage **8** in the lowered position will be described below.

An opening **1A** extends through the top surface of enclosure **1**, and opening **4A** extends through member **4**. An object to be toasted (e.g., bread slice **30** or **30'**) can be lowered through openings **1A** and **4A** until it rests on carriage **8**.

When carriage **8** is manually lowered into the lowered position (of FIGS. **2**, **4**, and **5**), a conventional electrical switch (not shown) is closed, thereby connecting a power supply (e.g., power supply **200** shown in phantom view in FIG. **1**) to heating elements **12**. Power supply **200** can have conventional design, but can be selected to be a less expensive (and less costly to operate) model that produces lower output power than would be required to enable a conventional toaster (without covers **14** and **15**) to toast bread to the same degree in the same time as can the inventive toaster (with covers **14** and **15**).

The power supply causes electrical current to flow through heating elements **12**, which raises the temperature of elements **12**, and thus the surrounding air in the toasting volume between elements **12**, to a high temperature. The heated air toasts an object (e.g., bread slice **30** or **30'**) resting on carriage **8** in the toasting volume.

Mica holding elements **6** are mounted to the toaster frame, and heating elements **12** are mounted to holding elements **6** in a vertical orientation. Each heating element **12** can be a mica card having a heating ribbon on the side facing the bread (not on the other side), or an array of quartz tubes with a heating ribbon (e.g., a coiled heating wire) inside each tube and a metal plate attached to the side of the tube array facing the bread. One heating element **12** is mounted between wire assembly **2** and a first one of insulation plates **11**, and the other heating element **12** is mounted between wire assembly **7** and a second one of insulation plates **11**.

When carriage **8** is manually lowered into the lowered position (of FIGS. **2**, **4**, and **5**), an electromagnetic solenoid (not shown) and a solid state timer (timer **202** shown in

phantom view in FIG. 1) are activated. The solenoid (and also the timer, the above-mentioned power supply and electrical switch, and the below-described mechanical latch) can be identical to that described in above-referenced British Patent Application Publication No. 2,285,389A. When activated, the solenoid exerts a magnetic force on handle member 31 which overcomes the biasing force of spring 29 and holds carriage 8 in the lowered position (while an object is toasted by power-consuming heating elements 12). In variations on the embodiment of FIGS. 1–6, the activated solenoid exerts a magnetic force on an element (other than handle member 31) fixedly attached to carriage 8 which overcomes the biasing force of spring 29 and holds carriage 8 in the lowered position.

Each of cover plates 14 and 15 rests on a pair of horizontal edges of plates 13 of the toaster frame (each plate rests on two parallel, horizontal edges, each edge on a different one of plates 13), so that each plate has freedom to slide horizontally on the edges.

The mechanism for sliding plates 14 and 15 between their "opened" and "closed" positions includes wire rack assemblies 2 and 7, spring elements 73 and 74 (shown in FIGS. 1 and 2), levers 48 and 49 and hinges 50 and 51 (shown in FIGS. 3 and 4), and spring wire 44 (shown in FIGS. 3 and 4). Arm 48A of lever 48 is rigidly attached to wire assembly 2, and arm 49A of lever 49 is rigidly attached to wire assembly 7. Spring element 73 has one end fixedly attached to wire assembly 2, and spring element 74 has one end fixedly attached to wire assembly 7. Each of spring elements 73 and 74 also has a free end that is free to move relative to the toaster frame, and that is positioned to be engaged by central ridge portion 8A of carriage 8. Arm 48B of lever 48 and arm 49B of lever 49 are also positioned to be engaged by a member (e.g., handle member 31) rigidly connected to carriage 8.

Lever 48 is rigidly attached to hinge 50, and hinge 50 is rotatably attached to an end plate 13 of the toaster frame. Lever 49 is rigidly attached to hinge 51, and hinge 51 is rotatably attached to the same end plate 13 of the toaster frame.

While carriage 8 is manually lowered into the lowered position shown in FIG. 2 (and FIG. 4) in response to user-exerted force on the handle assembly comprising member 31 and handle 32, portion 8A of carriage 8 engages spring elements 73 and 74, forcing elements 73 and 74 to rotate (and slightly bend) into the position shown in FIG. 2. Also while carriage 8 is manually lowered into the lowered position, handle member 31 (rigidly connected to carriage 8) engages arm 48B of lever 48 and arm 49B of lever 49, forcing lever 48 to rotate clockwise about hinge 50 (from the position shown in FIG. 3 to that shown in FIG. 4), and forcing lever 49 to rotate counter-clockwise about hinge 51 (from the position shown in FIG. 3 to that shown in FIG. 4). When carriage 8 has been manually lowered into the lowered position (of FIGS. 2 and 4), it is held in the lowered position by the downward force exerted by the above-described solenoid.

As lever 48 and element 73 rotate clockwise (away from the positions shown in FIGS. 1 and 3) they exert a clockwise torque on wire assembly 2 and thus assembly 2 rotates clockwise (together as a unit with lever 48) from the position shown in FIGS. 1 and 3 to the position shown in FIG. 2 or 4. Similarly, as lever 49 and element 74 rotate counter-clockwise (away from the positions shown in FIGS. 1 and 3) they exert a counter-clockwise torque on wire assembly 7 and thus assembly 7 rotates counter-clockwise (together as a unit with lever 49) from the position shown in FIGS. 1 and 3 to the position shown in FIG. 2 or 4. As a result of such rotation of assemblies 2 and 7, bread slice 30 (or 30') on carriage 8 is firmly gripped between (or its motion is constrained by) assemblies 2 and 7, the upper end of a rod of assembly 2 (which upper end is rotatably attached to slidably mounted plate 14 by hinge 2A) pulls plate 14 to the right (from the position shown in FIG. 3 to that shown in FIG. 2 or 4), and the upper end of a rod of assembly 7 (which upper end is rotatably attached to slidably mounted plate 15 by hinge 7A) pulls plate 15 to the left (from the position shown in FIG. 3 to that shown in FIG. 2 or 4).

With a sufficiently thin slice of bread on carriage 8 (e.g., slice 30 shown in FIG. 4), the bread slice does not prevent assemblies 2 and 7 from pulling plates 14 and 15 together until they meet (as shown in FIG. 4). In their position shown in FIG. 4, plates 14 and 15 completely (or substantially completely) cover the toasting volume, and heated air within the toasting volume recirculates during toasting in the directions of arrows A of FIG. 4.

With a sufficiently thick slice of bread on carriage 8 (e.g., slice 30' of FIG. 2, which is thicker than slice 30 of FIG. 4), the bread slice will engage and stop assemblies 2 and 7 (as shown in FIG. 2) before assemblies 2 and 7 have pulled cover plates 14 and 15 completely together. In their position shown in FIG. 2, plates 14 and 15 partially cover the toasting volume. With plates 14 and 15 partially covering the toasting volume during toasting, some heated air in the toasting volume escapes out from the toaster between plates 14 and 15 (as shown by arrows B in FIG. 2), but much of the air heated by heating elements 12 recirculates within the toasting volume substantially as shown by arrows A of FIG. 4 (and thus energy efficiency of the toaster is improved relative to the efficiency that the FIG. 2 toaster would have with covers 14 and 15 omitted).

Wire spring 44 is provided for separating wire assemblies 2 and 7 (and thus cover plates 14 and 15) when carriage 8 returns to its fully raised position (shown in FIG. 3). The left end of spring 44 is attached to member 46 (which is in turn fixedly attached to a rod of wire assembly 2), the central portion of member 46 is fixedly attached to the toaster frame, and the right end of spring 44 is attached to member 47 (which is in turn fixedly attached to a rod of wire assembly 7). When carriage 8 is lowered, wire assembly 2 rotates clockwise and pushes member 46 toward member 47 and wire assembly 7 rotates counter-clockwise and pushes member 47 toward member 46 (e.g., from the position shown in FIG. 3 to that shown in FIG. 4), thus causing spring wire 44 to bend (as shown in FIG. 4). Then (after a toasting operation) when carriage 8 rises to its fully raised position (shown in FIG. 3), wire 44 relaxes back to its normal, unbent position (shown in FIG. 3), thereby separating members 46 and 47 (and thus returning wire assemblies 2 and 7 and levers 48 and 49 to their vertical orientation as shown in FIG. 3).

The toaster frame (elements 4, 9, 11, and 13) and cover plates 14 and 15 are preferably made of plated steel. Enclosure 1 is preferably made of plated or painted steel, or (to make the toaster cool to the touch during operation) high temperature thermal plastic such as polypropylene or polycarbonate.

In variations on the described toaster, spring elements 73 and 74 are omitted (or levers 48 and 49 and optionally also spring wire 44 are omitted).

In other variations on the described toaster, the solenoid is omitted, and instead a mechanical latch means holds an

element rigidly attached to carriage **8** (such as member **31**) to keep carriage **8** in the fully lowered position during a toasting period determined by the timer. At the end of the toasting period, the timer sends a control signal to electrical circuitry within the toaster to disconnect the power supply from heating elements **12**. Then, when the user desires to remove the toasted food, the user manually actuates a control to release the mechanical latch, thus allowing spring **29** to pull up carriage **8** to the fully raised position (the upward movement of the carriage opens the cover over the toasting volume in the manner described above).

In some embodiments of the inventive toaster, the bread carriage is pulled up (by a spring such as spring **29**) from its fully lowered position all the way to its fully raised position automatically in response to deactivation or release of the means (e.g., the above-discussed solenoid or mechanical latch) which had held it in the lowered position during a toasting operation.

In other embodiments, the toaster includes means for latching the bread carriage in an intermediate position (between the lowered and raised positions) in response to deactivation (or release) of the means which had held it in the lowered position during a toasting operation. An example of such an embodiment is that shown in FIGS. **7** and **8**. This embodiment is almost identical to that of FIGS. **1–6** (and the elements of the embodiment of FIGS. **7** and **8** that correspond to those of the embodiment of FIGS. **1–6** are numbered identically in FIGS. **1–8**). Only those elements of FIGS. **7** and **8** that have not been described above with reference to FIGS. **1–6** will be described below.

With reference to FIGS. **7** and **8**, carriage **8** within the frame (not shown in FIGS. **7** and **8**) is rigidly connected to a handle assembly slidably mounted to rod **33** of the frame. The handle assembly comprises member **18** (rigidly connected to carriage **8**), bracket **19** rigidly attached to member **18**), and handle **32** (shown in FIG. **7**) which is attached to protruding arm portion **19B** of bracket **19**. Extension spring **29** is mounted with its upper end attached to the toaster frame and its lower end attached to arm **18A** of member **18** (so that spring **29** biases member **18** and the bread carriage attached thereto in their fully raised position). Latch **24** is hingedly attached to the toaster frame by elbow spring **25**.

Conventional circuitry, including a power supply (for heating elements **12**), a solenoid, and a timer, is housed in enclosure **1** in both the embodiments of FIGS. **1–6** and FIGS. **7–8**. At the end of a selected period of time after the timer is activated (in response to closure of a switch by movement of the carriage assembly to its lowered position), the timer generates a signal which deactivates the solenoid (thus allowing the carriage to rise sufficiently far to open the switch, which in turn disconnects the power supply from the heating elements). The user selects the duration of the selected time period by manipulating knob **28**.

Solenoid **23** is mounted to the toaster frame, and soft iron plate **22** is mounted to arm portion **19B** of bracket **19**. When a user manually lowers handle **32** (and bracket **19**, plate **22**, member **18**, and carriage **8** rigidly attached to handle **32**) into the fully lowered position, a switch (described above) activates solenoid **23**, to cause solenoid **23** to exert a magnetic force on plate **22** thereby holding the entire carriage assembly (carriage **8**, handle **32**, bracket **19**, plate **22**, and member **18**) in the fully lowered position.

At the end of a toasting operation, a timer (described above) deactivates solenoid **23** and decouples the toaster's heating elements from their power supply, allowing spring **29** to pull up the carriage assembly until arm **18B** of member **18** is caught by latch **24**. Latch **24** thus holds arm **18B** (and the entire carriage assembly) in the intermediate position shown in FIG. **8**.

One end of pin **26** is attached to the upper end of latch **24**, and button **26A** (shown in FIG. **7**) is attached to the other end of pin **26**. When a user presses button **26A**, latch **24** pivots away from arm **18B**, thereby releasing the carriage assembly so that spring **29** pulls the entire carriage assembly up to its fully raised position.

In the embodiment of FIGS. **7** and **8**, the carriage assembly (including carriage **8**) moves only a small distance from the fully lowered position to the intermediate position, and the cover (comprising plates **14** and **15**) over the toasting volume remains closed even when the carriage has moved to the intermediate position. This is also true in other embodiments of the invention. For example, in an implementation of the FIG. **4** embodiment which includes means for releasibly latching carriage **8** in an intermediate position, carriage **8** will typically be the position of carriage **8'** (shown in phantom view in FIG. **4**), which is only a short distance above the fully lowered position of carriage **8**. When the latch (not shown in FIG. **4**) retains carriage **8** in the intermediate position, member **31** engages arms **48B** and **49B** and retains them in substantially the position shown in FIG. **4**, and thus spring **44** remains bent (substantially as shown in FIG. **4**) when carriage **8** is in the intermediate position. Due to its bent configuration, spring **44** exerts a force on cover plates **14** and **15** which retains cover plates **14** and **15** in their closed position (shown in FIG. **4**) when carriage **8** is in the intermediate position. Thus, the invention slows the cooling of a toasted item on carriage **8** (after toasting), retaining the crispiness of the toasted item for a longer time, since the entire toasted item remains near heating elements **12** when the carriage is in the intermediate position (elements **12** will themselves cool slowly, after they have been disconnected from the power supply before carriage **8** enters the intermediate position) and since cover plates **14** and **15** remain closed thereby causing hot air to recirculate within the toasting volume even when carriage **8** is in the intermediate position. This has the benefit of keeping the toasted item warm and crisp until the user is ready to remove it from the toaster.

When the user wishes to remove the toasted item from a toaster whose carriage is in the intermediate position, he or she manually actuates a release control (e.g., presses a control such as button **26A** on the outside of the toaster), to release the latch which holds carriage **8** in the intermediate position, thus triggering the following actions: release of carriage **8** so that it is free to be pulled up by spring **29** to its fully raised position; and release of the carriage assembly component (e.g., member **31**) which had held arms **48B** and **49B** in a position keeping the inventive cover closed, making spring **44** free to relax and thereby open the inventive cover (i.e., separate assembly **2** from assembly **7** and cover plate **14** from cover plate **15**).

A suitable mechanical latch for latching the bread carriage of other embodiments of the invention in an intermediate position (after deactivation of a solenoid which had held the carriage in the fully lowered position) and a manually-actuatable release control for releasing the mechanical latch thereby allowing a spring to pull up the carriage to its fully raised position, are described in above-referenced British Patent Application Publication No. 2,285,389A.

In all variations of the embodiments of FIGS. **1–6** and **7–8**, the electric power supplied to the toaster's heating elements (e.g., heating elements **12**) should be limited so

that the temperature within each toasting volume, and the temperature at the toaster components surrounding the toasting volume (e.g., at closed plates **14** and **15**), during a toasting operation does not increase to a level that would cause the object being toasted or components of the toaster (e.g., the closed cover plates) to burn or melt. The material comprising the inventive toaster cover (e.g., the material comprising slidable plates **14–15**, or rotatable plates **80–83** to be described below) should be chosen to retain a desired amount of heat within the toasting volume. The toaster cover is made of metal in preferred embodiments, but it can be made of non-metallic, thermally insulating material in other embodiments. The material comprising the inventive toaster cover should be chosen so that it does not melt or burn during toasting.

We next describe another embodiment of the inventive toaster with reference to FIGS. **9–12**. In this embodiment, the toaster has two slots (toasting volumes). A cover designed in accordance with the invention is provided to cover each slot. Each cover comprises a pair of rotatably mounted plates (pair of plates **80** and **81** or pair of plates **82** and **83**). Each plate is preferably made of metal.

The toaster frame includes vertical side plates **111**, end plates **112** and **112'** (each fixedly attached to end plates **111**), horizontal top insulation member **113** connected between plates **111**, and end member **130** fixedly attached to end plate **112**. Two rivets **114** protrude from plate **112**, and two identical rivets **114** protrude from plate **112'**. Two slots **20**, which define tracks along which bread carriage **108** moves, extend through each of plates **112** and **112'**. Two rivets **99** protrude from plate **112**, a lever **101** is mounted to one of rivets **99**, and a lever **102** is mounted to the other of rivets **99**. Similarly, two rivets **99** (not shown) protrude from plate **112'**, a lever **101** (not shown) is mounted to one of these rivets **99**, and a lever **102** (not shown) is mounted to the other of rivets **99**.

Enclosure **110** (not shown in FIGS. **11** and **12**) surrounds the frame. The frame and cover plates **80**, **81**, **82**, and **83** are preferably made of plated steel. Enclosure **110** is preferably made of plated or painted steel, or (to make the toaster cool to the touch during operation) high temperature thermal plastic such as polypropylene or polycarbonate.

Carriage **108** (shown in phantom view in FIGS. **9** and **10**) is sized and shaped to support two slices of bread (one in each toasting volume), and is mounted within the frame with freedom to move relative to the frame along slots **20**. One end of carriage **108** (the end that rides in slots **20** in plate **112**) is rigidly connected to a handle assembly (which includes member **131**), and the handle assembly is slidably mounted to end member **130**. In response to force exerted on the handle assembly (typically by the hand of a human user), carriage **108** is lowered relative to the frame from the raised position shown in FIG. **9** to the lowered position shown in FIG. **10**. Carriage **108** is biased by an extension spring (not shown, but which is preferably identical to spring **29** of the embodiment of FIGS. **5** and **6**) to be normally in the raised position. The action of manually lowering carriage **108** to the lowered position thus overcomes the biasing force exerted by the spring. A means for releasibly locking carriage **108** in the lowered position (and/or in an intermediate position after release from the lowered position) is provided. This means is preferably identical to the means (described above with reference to FIGS. **1–6** or FIGS. **7–8**) for performing the corresponding functions in the embodiment of FIGS. **1–6** or FIGS. **7–8**, and the description thereof will not be repeated with reference to FIGS. **9–12**.

The toaster of FIGS. **9–12** also includes two plates **115**, each slidably mounted to one of end plates **112** and **112'** with freedom to move between a raised position shown in FIG. **9** (in which the lower ends of slots **115A** through plate **115** are stopped by rivets **114**) and the lowered position shown in FIG. **10** (in which the upper ends of slots **115A** are stopped by rivets **114**).

Each of levers **101** and **102** is mounted to a rivet **99** protruding from plate **112**, with freedom to pivot with respect to the rivet **99**. Spring **100** is attached between levers **101** and **102**. Spring **100** exerts a biasing force on levers **101** and **102** tending to separate the levers and thus to maintain the levers in the FIG. **9** orientation. Pin **101A** protruding from lever **101** is attached to bottom left portion **115B** of plate **115**, with lever **101** free to pivot relative to portion **115B** when plate **115** slides relative to plate **112**. Pin **102A** protruding from lever **102** is attached to bottom right portion **115C** of plate **115**, with lever **102** free to pivot relative to portion **115C** when plate **115** slides relative to plate **112**.

When carriage **108** is manually lowered from the FIG. **9** position to the FIG. **10** position, carriage **108** engages levers **101** and **102** and rotates levers **101** and **102** (about rivets **99**) from their positions shown in FIG. **9** to their positions shown in FIG. **10**. Rotating levers **101** and **102** overcome the biasing force exerted thereon by spring **100**, thus displacing spring **100** into the position shown in FIG. **10**. Also when levers **101** and **102** rotate into their FIG. **10** position, pins **101A** and **102A** pull plate **115** down to its lowered position shown in FIG. **10** (until rivets **114** stop further downward motion of plate **115** relative to plate **112**).

This downward motion of plate **115** causes cover plates **80**, **81**, **82**, and **83** to rotate into their closed positions (shown in FIGS. **10** and **11**) in which plates **80** and **81** cover the toasting volume on the toaster's left side and plates **82** and **83** cover the toasting volume on the toaster's right side. The manner in which this is accomplished will be described with reference to FIG. **10A**, which is an enlarged view of a portion of the FIG. **10** apparatus.

Plate **80** consists of a flat central plate portion, and flat rod portion **80A** protruding from each end of the central portion. The flat surface of each rod portion **80A** is oriented at an acute angle relative to the central portion (as best shown in FIG. **10A**). Each of plates **81**, **82**, and **83** also consists of a flat central plate portion with a flat rod portion (**81A**, **82A**, and **83A**, respectively) protruding from each end of the central portion. End portions **80A**, **81A**, **82A**, and **83A** are rotatably mounted to the toaster frame (so that plates **80–83** are free to rotate but not translate relative to the toaster frame).

Each plate **115** has four curved slots (**85**, **86**, **87**, and **88**) extending therethrough. As best shown in FIG. **10A**, slot **85** provides a track along which rod portion **80A** of cover plate **80** "rides" (slot **87**, identical to slot **85**, provides a track along which rod portion **82A** of plate **82** rides) when plate **115** translates up or down relative to the toaster frame, and slot **86** provides a track along which rod portion **81A** of cover plate **81** rides (slot **88**, identical to slot **86**, provides a track along which rod portion **83A** of plate **83** rides) when plate **115** translates up or down relative to the toaster frame. When levers **101** and **102** pull down plates **115** into the position shown in FIG. **10** (and FIG. **10A**), the downward-moving plates **115** rotate cover plates **80**, **81**, **82**, and **83** until the cover plates reach their closed positions shown in FIG. **10** and FIG. **10A** (by the action of slots **85**, **86**, **87**, and **88**, on rod portions **80A**, **81A**, **82A**, and **83A**, respectively, as the rod portions ride along the slots to the outer ends of the slots).

When carriage **108** is released (so that its bias spring pulls it up to the FIG. **9** position, spring **100** relaxes to its FIG. **9**

position, thereby returning levers **101** and **102** to their FIG. **9** position. As levers **101** and **102** return to their FIG. **9** position, pins **101**A and **102**A push plates **115** up to their raised position. The upward-moving plates **115** rotate cover plates **80**, **81**, **82**, and **83** until the cover plates reach their opened positions shown in FIG. **9** (by the action of slots **85**, **86**, **87**, and **88**, on rod portions **80**A, **81**A, **82**A, and **83**A, respectively, as the rod portions ride along the slots to the inner ends of the slots). With the covers opened, toasted bread can be removed from the bread carriage.

In variations on the embodiment of FIGS. **9–12**, when the bread carriage is manually lowered by the user, other mechanical linkages attached to the carriage rotate a pair of cover plates so that they cover a toasting volume. Then, when the carriage springs up (after a toasting operation), the mechanical linkages rotate the plates in the opposite directions to uncover the toasting volume and allow removal of the toasted object.

Various other modifications and alterations in the apparatus of the invention will be apparent to those skilled in the art. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments.

What is claimed is:

1. A toaster, including:

a frame enclosing a toasting volume, wherein the frame defines an opening for admitting an object into the toasting volume;

a carriage assembly;

a member rigidly attached to the carriage assembly, wherein the member is translatably engaged with the frame so that the carriage assembly is movable relative to the frame between a raised position and a lowered position in the toasting volume in response to translation of the member relative to the frame;

a mechanical link assembly having a first configuration and a second configuration, wherein the mechanical link assembly enters the first configuration in response to the carriage assembly moving to the lowered position and engaging a portion of said mechanical link assembly, and wherein the mechanical link assembly enters the second configuration in response to the carriage assembly moving to the raised position; and

a cover attached to the mechanical link assembly, wherein the mechanical link assembly holds the cover in a first position at least partially covering the opening when the mechanical link assembly is in the first configuration, and wherein the mechanical link assembly holds the cover in a second position uncovering the opening when the mechanical link assembly is in the second configuration, wherein the cover includes a first plate slidably mounted to the frame and a second plate slidably mounted to the frame, and wherein the mechanical link assembly includes:

means for sliding the first plate and the second plate into positions at least partially covering the opening in response to movement of the carriage assembly into the lowered position.

2. The toaster of claim **1**, also including:

heating elements; and

power supply means for supplying power to the heating elements in response to entry of the mechanical link assembly into the first configuration, and for decoupling the power from the heating elements in response to a timer signal generated on termination of a toasting period after entry of the mechanical link assembly into the first configuration, wherein the carriage assembly enters the raised position automatically thereby causing the mechanical link assembly to enter the second configuration in response to assertion of the timer signal.

3. The toaster of claim **1**, also including:

heating elements;

power supply means for supplying power to the heating elements in response to entry of the mechanical link assembly into the first configuration, and for decoupling the power from the heating elements in response to a timer signal generated upon termination of a toasting period after entry of the mechanical link assembly into the first configuration;

carriage biasing means for urging the carriage assembly to the raised position;

latch means for releasibly holding the carriage assembly in the lowered position in response to the carriage assembly moving to said lowered position;

latch release means for releasing said latch means in response to an external force applied after assertion of the timer signal, thereby allowing the carriage biasing means to move the carriage assembly to the raised position.

4. The toaster of claim **1**, wherein the cover substantially totally covers the opening when the mechanical link assembly is in the first configuration.

5. The toaster of claim **1**, wherein the frame also encloses a second toasting volume and the frame also defines a second opening for admitting a second object into the second toasting volume, and wherein the toaster also includes:

a second mechanical link assembly having a first member attached to the carriage assembly, wherein the second mechanical link assembly enters a first configuration in response to the carriage assembly moving to the lowered position, and wherein the second mechanical link assembly enters a second configuration in response to the carriage assembly moving to the raised position; and

a second cover attached to the second mechanical link assembly, wherein the second mechanical link assembly holds the second cover in a first position at least partially covering the second opening when the mechanical link assembly is in the first configuration, and wherein the second mechanical link assembly holds the second cover in a second position uncovering the second opening when the second mechanical link assembly is in the second configuration.

6. The toaster of claim **1**, wherein the means for sliding the first plate and the second plate includes:

a first subassembly movably mounted to the frame, and having a top end connected to the first plate and a bottom end positioned for engagement by the carriage assembly when said carriage assembly moves into the lowered position, wherein the first subassembly moves the first plate into a position at least partially covering the opening in response to the carriage assembly engaging the bottom end of the first subassembly when said carriage assembly moves into the lowered position; and

a second subassembly movably mounted to the frame and having a top end connected to the second plate and a bottom end positioned for engagement by the carriage assembly when said carriage assembly moves into the lowered position, wherein the second subassembly

moves the second plate into a position at least partially covering the opening in response to the carriage assembly engaging the bottom end of the second subassembly when said carriage assembly moves into the lowered position.

7. The toaster of claim **6**, wherein the first subassembly includes:

a hinge means rotatably mounted to the frame;

a first lever arm having one end attached to the hinge means;

a second lever arm having one end attached to the hinge means and whose opposite end is said bottom end of the first subassembly; and

a wire assembly rigidly attached to the first lever arm and having an upper portion which is said top end of the first subassembly.

8. The toaster of claim **7**, wherein the second subassembly includes:

a second hinge means rotatably mounted to the frame;

a third lever arm having one end attached to the hinge means

a fourth lever arm having one end attached to the second hinge means and whose opposite end is said bottom end of the second subassembly; and

a second wire assembly rigidly attached to the third lever arm and having an upper portion which is said top end of the first subassembly, and wherein the means for sliding the first plate and the second plate also includes:

spring means attached between the wire assembly and the second wire assembly, for exerting a biasing force urging said wire assembly away from said second wire assembly and thus the first plate away from the second plate, wherein said wire assembly and said second wire assembly overcome said biasing force and move together in response to movement of the carriage assembly into the lowered position.

9. A toaster, including:

a frame enclosing a toasting volume, wherein the frame defines an opening for admitting an object into the toasting volume;

a carriage assembly;

a member rigidly attached to the carriage assembly, wherein the member is translatably engaged with the frame so that the carriage assembly is movable relative to the frame between a raised position and a lowered position in the toasting volume in response to translation of the member relative to the frame;

a mechanical link assembly having a first configuration and a second configuration, wherein the mechanical link assembly enters the first configuration in response to the carriage assembly moving to the lowered position and engaging a portion of said mechanical link assembly, and wherein the mechanical link assembly enters the second configuration in response to the carriage assembly moving to the raised position; and

a cover attached to the mechanical link assembly, wherein the mechanical link assembly holds the cover in a first position at least partially covering the opening when the mechanical link assembly is in the first configuration, and wherein the mechanical link assembly holds the cover in a second position uncovering the opening when the mechanical link assembly is in the second configuration, wherein the cover includes a first plate rotatably mounted to the frame and a second plate rotatably mounted to the frame, and wherein the mechanical link assembly includes:

means for rotating the first plate and the second plate into positions at least partially covering the opening in response to movement of the carriage assembly into the lowered position, wherein the means for rotating the first plate and the second plate includes:

a sliding plate slidably mounted to the frame, wherein there is a first slot and a second slot in said sliding plate, the first plate has an end portion which extends through the first slot, and the second plate has an end portion which extends through in the second slot.

10. The toaster of claim **9**, wherein the end portion of the first plate is rotatably mounted to the frame, the end portion of the second plate is rotatably mounted to the frame, wherein the sliding plate translates in response to movement of the carriage assembly into the lowered position thereby causing the first slot to rotate the end portion of the first plate in a first rotational direction as said end portion of the first plate rides in the first slot during said translation, and causing the second slot to rotate the end portion of the second plate in a second rotational direction as said end portion of the second plate rides in the second slot during said translation.

11. A toaster, including:

a frame enclosing a toasting volume, wherein the frame defines an opening for admitting an object into the toasting volume;

a carriage assembly;

a member rigidly attached to the carriage assembly, wherein the member is translatably engaged with the frame so that the carriage assembly is movable relative to the frame between a raised position and a lowered position in the toasting volume in response to translation of the member relative to the frame;

a pair of cover plates movably mounted to the frame; and

means for moving the cover plates into a first configuration at least partially covering the opening in response to movement of the carriage assembly into the lowered position, and for moving the cover plates into a second configuration uncovering the opening in response to movement of the carriage assembly into the raised position, wherein the cover plates are slidably mounted to the frame, and wherein the means for moving the cover plates is a mechanical link assembly including:

means for sliding the cover plates into the first configuration in response to movement of the carriage assembly into the lowered position.

12. The toaster of claim **11**, wherein the cover plates substantially totally cover the opening when in said first configuration.

13. The toaster of claim **11**, wherein the cover plates include a first plate and a second plate, and wherein the means for sliding the cover plates includes:

a first subassembly movably mounted to the frame, and having a top end connected to the first plate and a bottom end positioned for engagement by the carriage assembly when said carriage assembly moves into the lowered position, wherein the first subassembly moves the first plate into a position at least partially covering the opening in response to the carriage assembly engaging the bottom end of the first subassembly when said carriage assembly moves into the lowered position; and

a second subassembly movably mounted to the frame and having a top end connected to the second plate and a

bottom end positioned for engagement by the carriage assembly when said carriage assembly moves into the lowered position, wherein the second subassembly moves the second plate into a position at least partially covering the opening in response to the carriage assembly engaging the bottom end of the second subassembly when said carriage assembly moves into the lowered position, wherein the first subassembly includes:

a hinge means rotatably mounted to the frame;

a first lever arm having one end attached to the hinge means;

a second lever arm having one end attached to the hinge means and whose opposite end is said bottom end of the first subassembly; and

a wire assembly rigidly attached to the first lever arm and having an upper portion which is said top end of the first subassembly.

14. A toaster, including:

a frame enclosing a toasting volume, wherein the frame defines an opening for admitting an object into the toasting volume;

a carriage assembly;

a member rigidly attached to the carriage assembly, wherein the member is translatably engaged with the frame so that the carriage assembly is movable relative to the frame between a raised position and a lowered position in the toasting volume in response to translation of the member relative to the frame;

a pair of cover plates movably mounted to the frame; and

means for moving the cover plates into a first configuration at least partially covering the opening in response to movement of the carriage assembly into the lowered position, and for moving the cover plates into a second configuration uncovering the opening in response to movement of the carriage assembly into the raised position, wherein the cover plates are rotatably mounted to the frame, and wherein the means for moving the cover plates is a mechanical link assembly including:

means for rotating the cover plates into the first configuration in response to movement of the carriage assembly into the lowered position, wherein the cover plates include a first plate and a second plate, and wherein the means for rotating the cover plates includes:

a sliding plate slidably mounted to the frame, wherein there is a first slot and a second slot in said sliding plate, the first plate has an end portion which extends through the first slot, and the second plate has an end portion which extends through in the second slot.

* * * * *